Effectiveness of Ipomoea Aqua Forsk in Phosphate Absorption and pH Neutralization of Detergent Wastewater

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Abstract

One of the causes of environmental pollution is the direct disposal of wastewater into the environment. Disposal of wastewater both originating from domestic (household) and industrial activities into water bodies can cause environmental pollution. As one example, namely laundry waste that is discharged directly into water bodies. The high phosphate content in the laundry waste causing an algae boom and can reduce dissolved oxygen content so that it will result in the death of aquatic biota. The purpose of this study was to find out the optimization Phosphate absorption and pH neutralization of laundry wastewater using Ipomoea sp (Ipomoea Aqua Forsk) in Batam City. This research is an Experimental study with a One Group Pretest-Posttest Design design. Waste samples were taken in one of the laundry businesses located in kel. Sadai, kec. Confused. The subject of this research is the Ipomoea sp., and the object of this research is the level of phosphate and pH contained in laundry wastewater. The results of the treatment that the researchers carried out in treatment I obtained the optimal weight was 500gr of Ipomoea sp growth and could reduce phosphate levels to 0.13 mg/L, and pH to 8.10 pH units, while in treatment II the optimal length of time was 6 days to be able to lowered the phosphate level to 0.09 mg/L, and the pH to 7.60 pH units. The conclusion of this study is that the optimal weight of Ipomoea sp. is 500 grams and the optimal length of time is 6 days. Suggestions from this study are, laundry business owners and the surrounding community are encouraged to Ipomoea sp along the ditches through which laundry waste water passes.

Keywords:* *Ipomea Sp, Laundry, Phosphate, Ph, Wastewater

INTRODUCTION

The problem of environmental pollution is a problem that can cause disruption to public health (Ramadhani & Sianturi, 2021). One of the causes of environmental pollution is the direct disposal of wastewater into the environment (Biniaz et al., 2021). Disposal of wastewater both originating from domestic (household) and industrial activities into water bodies can cause environmental pollution if the quality of wastewater does not meet wastewater quality standards. As one example, namely laundry waste that is discharged directly into water bodies (Jawecki et al., 2017).

Laundry is one of the businesses that is developing along with the increase in population growth and urbanization in urban areas (Zairinayati & Shatriadi, 2019), especially the city of Batam. Besides that, the laundry business produces liquid waste every day, the increase in the amount of waste resulting from washing clothes produced has a direct impact on the environment if it is not managed and treated properly because this laundry waste can contaminate water bodies and soil (Zairinayati & Shatriadi, 2019).

The number of laundry businesses has not been recorded with certainty, but the development of the laundry business has reached every sub-district and village throughout Batam City. As one of the cities with rapid industrial and economic development, various industries can grow well as well as industries engaged in services such as the laundry business.

In Batam City there are 12 Districts. Among the 12 sub-districts in Batam City, Kec. Bengkong is one of the sub-districts that has a dense population of 68,873 people with an area of 19,272 Ha, which consists of 5 Villages (Badan Pusat Statistik Kota Batam, 2021). In each Kelurahan in Bengkong District, laundry businesses have mushroomed at several points. One of them is in the Sadai Village, the laundry businesses that have spread in this Kelurahan have reached ± 73 laundry businesses with the distance between one and the other not too far apart from that the position of the laundry business is also in the middle of the surrounding community, there are even 2 laundry businesses flanking 1 community house.

According to the results of the researcher initial observations, 10 of the laundry businesses spread across the Sadai Village, Bengkong District, did not find a special tool used to manage the remaining liquid waste from the laundry business. in the laundry business this happens every day from 09.00 in the morning to 21.00 in the evening. If this continues to be done, eutrophication will occur where water bodies become rich in dissolved nutrients, causing an algae boom and can reduce dissolved oxygen content which will result in the death of aquatic biota (Zairinayati & Shatriadi, 2019).

In every laundry business it can produce liquid waste which has a concentration of Total Phosphate parameter values of 18.07-19.86 mg/l (Tsabity & IW, 2017). The high phosphate content in the laundry waste and it is disposed of without being processed first, plays a role in eutrophication where water bodies become rich in dissolved nutrients, causing an algae boom and can reduce dissolved oxygen content so that it will result in the death of aquatic biota (Zairinayati & Shatriadi, 2019). To minimize this impact, it is necessary to make efforts to treat laundry business waste water effectively and efficiently and be made with simple construction and materials (Rahimah et al., 2016).

Phytoremediation is a solar-controlled remediation strategy that is inexpensive, efficient, can be applied in-situ in the absorption of metals and pollutants from soil and water using aquatic plants (Ahmad & Adiningsih, 2019; Rosita et al., 2013; Sukono et al., 2020). To reduce water pollution from laundry waste, efforts are being made to carry out phytoremediation using aquatic plants. Aquatic plants such as water hyacinth (Eichhornia crassipes) (Sari, 2014), water lily (Pistia stratiotes) (Toepak et al., 2020), water spinach (Ipomoea aquatica Forsk), duckweed (Lemna sp), and other aquatic plants are known to be able to improve the quality of laundry wastewater (Fajarianingtyas et al., 2021). One of the aquatic plants, namely water spinach, can have an influence in improving the quality of liquid waste in oil palm (Suryati, 2020). From the results of Ahmad's research (2019) it states that water spinach plants have effectiveness reduction of COD, BOD, pH, DO, Turbidity, temperature, phosphate, ammonia, nitrate, total nitrogen, reducing orthophosphate content in detergents (Ahmad & Adiningsih, 2019).

The purpose of this study was to determine the optimization of phosphate absorption and pH neutralization of laundry wastewater using *Ipomoea sp (ipomoea aqua forsk)*. In addition, this research can also determine the optimal weight of *Ipomoea sp* in the process of absorbing phosphate levels and neutralizing the pH in laundry wastewater and can determine the optimal length of time needed in the process of absorbing phosphate levels and neutralizing the pH in laundry wastewater.

METHODS

This research is an experimental research. The research design used in this study is the One Group Pretest-Posttest Design, this is in line with the opinion (Sugiyono, 2018) which states "the experimental research design includes the One Group Pretest-Posttest Design". In this design, the initial measurement (Pretest) was carried out by taking the sample directly then given the treatment. After being given treatment, the results of the two experiments were tested with the same test as the final test (Posttest) and the results of the two were compared (Tanzeh & Arikunto, 2020).

The sampling location was carried out at one of the laundry businesses in Sadai Village, Bengkong District, and sample testing was carried out at the Sucofindo Laboratory, Batam, Riau Islands Province. Meanwhile, this research will be conducted from June 2022 to October 2022.

The materials used were Ipomoea Aqua Forsk and laundry wastewater (19 L). The tools used include 19L plastic containers, containers for experimental tests, water faucets, bottles for

storing water samples. This work procedure is a modification of Fitri Dewi's work procedure, et al (2015).

Sampling

a. Clean the bottle to collect the laundry wastewater sample using soap, then rinse thoroughly and make sure the bottle doesn't leak.
b. Fill the bottle with the laundry waste water sample until it is full as much as ± 19 liters, then close the bottle tightly.

Delivery of Samples Before Treatment

The samples that have been taken are then taken directly to the Sucofindo Batam laboratory to be tested for pH levels and phosphate levels contained in laundry wastewater.

Treatment Process

a. To find the optimal weight of water spinach
   1) Ipomoea sp. is put into a container where the experimental test has been labeled and contains laundry waste water, put 1 bunch of water spinach plants in 1 container with different weights of Ipomoea sp., namely: Container 1 = 1 bunch of Ipomoea sp. weighing 100 grams; Container 2 = 1 bunch of Ipomoea sp. weighing 200 grams; Container 3 = 1 bunch of Ipomoea sp. weighing 300 grams; Container 4 = 1 bunch of Ipomoea sp. weighing 400 grams; Container 5 = 1 bunch of Ipomoea sp. weighing 500 grams,
   2) Observe each container within 10 days,
   3) After the tenth day, take samples from each container, to do laboratory tests at Sucofindo Batam. Don't forget to give name/code for each sample.

b. To Find Optimal Time on Experiments
   1) After obtaining the optimal weight in the treatment process, then we will only use the most optimal weight for the process of finding the optimal length of time in the phytoremediation process in this experiment,
   2) Clean the container that has been used in the previous experimental test, Then put the laundry waste water into the container as much as 1.5 L, and Put Ipomoea sp. with optimal weight into the container. Make observations for 10 days, Take samples from each container on day 2, 4, 6, 8, 10.
   3) Laboratory tests every time when take a sample. Don't forget to label each sample.

Sending Samples After Treatment and Waiting for Lab Test Results

The samples that had been treated were then brought back to be tested by the Sucofindo Batam laboratory to find out the optimization of the simple design method that had been carried out.

The subjects in this study were *Ipomoea sp,* while the objects in this study were the phosphate levels and pH levels contained in laundry wastewater. Primary data collection is done by making observations (observations) and measurements of the research sample that has been planned. The data taken directly in the field are samples of liquid waste tested in the laboratory. Sampling was taken directly at one of the laundries in the city of Batam, Kec. Bengkong, researchers took a sample of 19L and then checked the sample before treatment at the Sucofindo laboratory, Batam.

The data analysis technique in this study was laboratory analysis, to determine the quality of the laundry wastewater in terms of phosphate levels and pH levels as well as the feasibility of reusing the laundry water after being treated with a simple processing method using *Ipomoea sp*. Then compared with the Regulation of the Minister of Environment of the Republic of Indonesia Number 5 of 2014 concerning waste water quality standards for businesses and/or industrial activities for soap, detergent and vegetable oil products.

RESULTS

a. Analysis Results of Laundry Wastewater Quality Before Processing

Table 1. Analysis Results of Laundry Wastewater Quality Before Experiment

No	Parameter	Unit	Result	Quality Standards According to Minister of Environment No. 5 Year 2014
1.	Phosphate	mg/L	44.90	2.0
2.	pH	pH Units	13,10	6,0 – 9,0

From the table above it is known that the phosphate levels in the laundry waste water are taken directly from one of the laundry businesses located in the kel. Sadai, Kec. Bengkong, with the results of the examination of phosphate levels reaching 44.90 mg/L, this result exceeds the quality standard of Permen LH no. 5 of 2014, while the results of the examination of pH levels were 13.10 pH Units, exceeding the quality standards set according to Permen LH no. 5 of 2014. it can be concluded that the wastewater contains materials that can reduce the quality of the environment through which the laundry waste passes.

b. Results of Treatment I (find optimal weight)

Table 2. Differences in Quality of Laundry Wastewater Before and After Treatment I (knowing the optimal weight)

No	Parameter		After Treatment	Quality Standards

		Before Treatment	100gr	200gr	300gr	400gr	500gr	
1.	*Phosphate*	44,90 mg/L	0,10	0,10	0,12	0,11	0,13	2,0 mg/L
2.	pH	13,10 pH	10,35	10,05	9,59	9,05	8,10	6,0-9,0 pH units

From the table can be seen that the results of laboratory tests conducted by researchers at the Sucofindo laboratory, there was a change from laundry wastewater that had not been treated I to laundry wastewater that had been treated I. *Ipomoea sp*. which has a value of phosphate levels and pH levels which is below the quality standard according to Minister of Environment Regulation no. 5 of 2014 is a container with *Ipomoea sp*. weighing 500 grams. While containers containing 100gr, 200gr, 300gr, and 400gr of *Ipomoea sp* also have a phosphate level value below the quality standard of the Minister of Environment, but the pH level is still high and has not been included in the quality standard of laundry wastewater according to the Minister of Environment Regulation no. 5 of 2014. So to continue treatment II to find the optimal length of time, researchers used *Ipomoea sp* weighing 500 grams.

c. Results of Treatment II (looking for optimal length of time)

Next, the researcher continues treatment II which aims to find the optimal length of time by using 500 grams of *Ipomoea sp* and observing it for 10 days. In addition, researchers will also take samples every two days to find out on which day the phosphate levels and pH levels become normal according to the Minister of Environment Regulation no. 5 of 2014, and the following results.

Table 2. Differences in Quality of Laundry Wastewater Before and After Treatment II using 500gr (knowing the optimal length of time)

No	Parameter	Before Treatment	After Treatment					Quality Standards
			Day-2	Day-4	Day-6	Day-8	Day-10	
1.	*Phosphate*	44,90 mg/L	0,08	0,17	0,09	0,06	0,09	2,0 mg/L
2.	pH	13,10 pH	10,16	9,96	7,60	6,70	6,55	6,0-9,0 pH units

From the table above it can be seen that phosphate levels decreased from the 2nd to the 10th day and were immediately below the NAV, and in accordance with the quality standards set by Permen LH no. 4 of 2015 concerning laundry wastewater quality standards. Meanwhile, the pH level only decreased to neutral on the 6th day, so the optimal length of time in this study was 6 days.

DISCUSSION

a. Optimal Weight of *Ipomoea sp*. on the Absorption Process of Phosphate Levels and pH Neutralization in Laundry Wastewater

In the results of treatment I which explained that the laundry wastewater after treatment had a very significant difference in terms of phosphate levels and pH levels in the laundry wastewater with varied weight of *Ipomoea sp*.. From the first treatment that the researchers carried out in order to find out the optimal weight of *Ipomoea sp* in the first treatment process, the most optimal weight was obtained was a container containing 500 grams of *Ipomoea sp*, where the most optimal results were obtained including phosphate levels which were in accordance with the quality standards of laundry waste water in accordance with the LH regulation, and a balanced pH level in accordance with the laundry waste water quality standards in accordance with the LH regulation.

In treatment I, which the researchers used to obtain the most optimal *Ipomoea sp*. weight, had various results. It can be seen from the results of treatment I, which explained that containers containing *Ipomoea sp* below 400 grams could not neutralize the pH levels contained in the laundry wastewater, while the containers which contains *Ipomoea sp* above 400gr can properly neutralize pH levels in accordance with the quality standards of laundry waste water that has been set by the Minister of Environment Regulation No. 5 of 2014 (Kementrian Lingkungan Hidup dan Kehutanan, 2014). However, *Ipomoea sp* can reduce phosphate levels in laundry wastewater very well even if only using 100gr just *Ipomoea sp*.

From the results of this first treatment, researchers will carry out further treatment to treatment II which aims to obtain the optimal length of time needed to reduce phosphate levels and neutralize pH levels in laundry wastewater by using *Ipomoea sp* that have the most optimal weight, namely *Ipomoea sp*. as much as 500gr. The reason the researchers used 500 grams of *Ipomoea sp* was because the laundry waste water in a container containing 500 grams of *Ipomoea sp* had decreased in phosphate levels and had the most balanced pH level compared to other containers.

This is because water *Ipomoea sp.* are able to carry out the phytoremediation process very well. According to Sari (2014) plants that can be used as phytoremediation media have several requirements, including: fast growing, being able to absorb large amounts of water, being able to remediate more than one pollutant, and having a high tolerance for pollutants, all of the requirements needed to as a phytoremediation medium for laundry wastewater in this experiment is very much owned by water *Ipomoea sp* (Sari, 2014).

In this experiment the researchers were able to reduce phosphate levels and neutralize the pH of laundry wastewater which was originally high and unbalanced, to be low and balanced in accordance with laundry wastewater quality standards which has been stipulated by Minister of Environment No. 5 of 2014.

Researchers pay close attention to the quality of water *Ipomoea sp.* during the research process for the smooth running of experiments to reduce phosphate levels and neutralize pH levels in laundry wastewater. The most important factors in the growth of water *Ipomoea sp.* are temperature, oxygen, and sunlight, if one of the components needed is not present, the water *Ipomoea sp.* cannot develop properly, and even die (Fitri Dewi et al., 2015).

Pollutant absorption by plants is divided into 3, namely 1) Absorption by roots, pollutants are carried into the solution around the roots, 2) translocation of pollutants from roots to parts of the plant body, 3) localization of pollutants in cells and tissues, for example by accumulating pollutants in certain organs such as roots, leaves, and vacuoles (Jóźwiakowski et al., 2021).

The root is an organ of the water *Ipomoea sp.* that functions to absorb water, nutrients, and organic matter in the medium. Absorption of pollutants by water *Ipomoea sp.* roots causes a decrease in pollutant levels in water. In water *Ipomoea sp.* the concentration of Cadmium/Cd is found in the greatest amount in the roots because in the soil the roots are the first part of the plant to interact directly with Cd through the rhizosphere. The high concentration of metals in the soil causes the roots to attract metals with large concentrations compared to other parts of the plant (Hapsari et al., 2018).

Cadmium in water *Ipomoea sp.* roots affects physical and chemical environmental factors, including pH and other pollutants (La Tiro, Lusiani.I, Isa. H, 2017). The presence of cadmium in media with high concentrations makes the pH decrease. The greater the concentration of cadmium in the media, the lower the pH value of the media, this is because phosphate is acidic (Genchi et al., 2020).

According to the researchers' assumptions, the weight of *Ipomoea sp*., which varies in each container, greatly affects the phosphate levels and pH levels contained in the laundry wastewater, besides that the quality of the *Ipomoea sp*. also affects the decrease or increase of phosphate levels and pH levels so that the decrease and increase in each container occurs irregularly (La Tiro, Lusiani.I, Isa. H, 2017).

The results that the researchers got from treatment I were very much in line with previous researchers by Fitri Dewi, et al (2015) that a simple treatment aimed at lowering phosphate levels and neutralizing the pH in laundry wastewater using *Ipomoea sp.* was very influential, because the phosphate content in laundry waste water almost disappears and the pH level is

very nearly balanced, so laundry waste water is safe to dispose of into the surrounding environment (Fitri Dewi et al., 2015).

This research is not in line with research conducted by Putra (2021) which found that the water spinach plant (Ipomoea aquatica Forsk) is influential and effective in reducing laundry waste in temperature parameters, but the water spinach plant (Ipomoea aquatica Forsk) has no effect in reducing laundry waste on the parameters BOD, COD, TSS, Phosphate, Turbidity, and pH (Putra & Cahyonugroho, 2021).

b. Optimal Time Length of *Ipomoea sp*. on the Absorption Process of Phosphate Levels and pH Neutralization in Laundry Wastewater

The results of treatment II which aims to obtain the optimal time in the phytoremediation process of water *Ipomoea sp.* in reducing phosphate levels and neutralizing pH levels can be seen in the results of treatment II which explain that the pH levels and phosphate levels of laundry wastewater change every day, to reduce phosphate levels. by using *Ipomoea sp.* as much as 500 grams to the levels set by the quality standards of laundry waste water in accordance with the Minister of Environment Regulation no. 5 of 2014 only took 2 days, because on the second day the decrease in phosphate levels occurred very drastically when checked at the Sucofindo laboratory, Batam. Unlike the case with the pH levels contained therein, on the 2nd day the pH levels of the laundry wastewater were still not balanced at 10.16. The decrease in pH occurred when the study had been running for 6 days, as evidenced by the pH level which had started to be neutral, namely 7.60, while the phosphate level was still balanced from day to day.

The amount of pollutant accumulation corresponds to the concentration of cadmium in *Ipomoea sp.* and the time of exposure. The greater the cadmium concentration and the longer the exposure time, the higher the pollutant levels absorbed by the *Ipomoea sp.* and conversely the smaller the cadmium concentration and the exposure time, the lower the pollutant levels absorbed by the *Ipomoea sp* (Wenqing et al., 2017).

According to the researchers' assumptions, the longer the time the *Ipomoea sp.* are exposed to the wastewater, the more pollutants are absorbed by the *Ipomoea sp.* so that the laundry wastewater does not have high pollutant levels like before this simple treatment was carried out.

The results that the researchers got from treatment II were very much in line with previous research by Utami that variations in time in the experimental process using plants in reducing pollutant levels in laundry wastewater were very influential and always changing from day to

day, the longer the time. which is used in the treatment process, the more the decrease in pollutant levels in the laundry wastewater (Janpoor et al., 2011).

This research is in line with the research of Raissa (2017) which stated that there was no difference in the efficiency of reducing phosphate levels in laundry liquid waste with Azolla microphylla plants (Raissa & Tangahu, 2017). This is because during the treatment time the temperature in the treatment decreased from before treatment which had an average of 29°C while during the treatment the temperature ranged from an average of 26°C – 27°C (Munthe et al., 2021). Temperature is an important factor in waste handling. At high temperatures the oxidation of organic matter is greater. At high temperatures this will support the decomposition activity of alkyl benzene sulfonate which is difficult to decompose. As a result of this overhaul, the pH value will decrease (Nono et al., 2020).

This is in accordance with the results of the study Toepak (2020) which stated that jeringau phytoremediation can produce a neutral pH of 7.1, so that in the processing of laundry waste there is no need for a neutralization process to obtain an ideal pH (Toepak et al., 2020). The decrease in pH was accompanied by a decrease in phosphate, this was also in accordance with Vidyanti's research which stated that on day 10 the pH became ideal, namely 8 and the phosphate decreased to 8.4 Mg/L (Vidyanti et al., 2020).

CONCLUSIONS

1. Ipomoea sp. weighing 500gr is the most effective weight for reducing phosphate levels and neutralizing laundry waste.
2. The most optimal length of time for the phytoremediation process using Ipomoea sp. as much as 500gr of laundry waste water is 6-10 days.
3. Suggestion for owners of the laundry business are expected to *Ipomoea sp.* along the streams that are passed by the results of the laundry waste water so that when the laundry wastewater reaches water bodies, or ponds, etc., the pollutants contained in the laundry waste water do not contaminate the surrounding area.

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